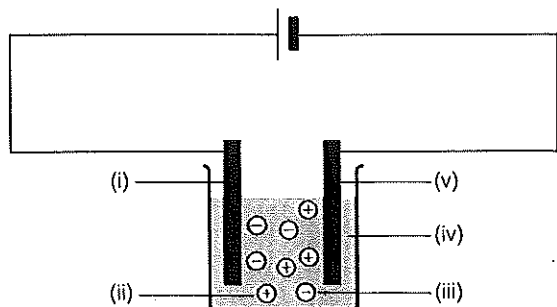
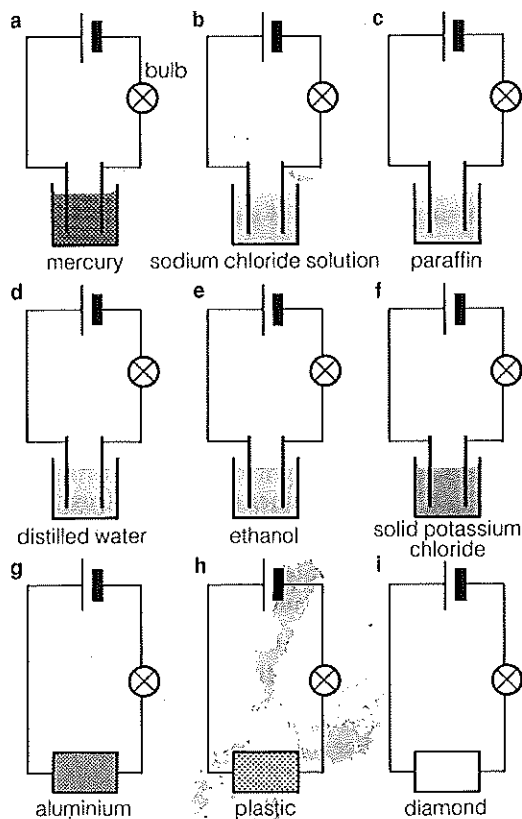


Electrolysis - Section 1c

- 1 a What does the term *electrolysis* mean?
 b Copy the diagram below, and label it using the words in this list, which are all connected with electrolysis:
anode, cathode, electrolyte, anion, cation.

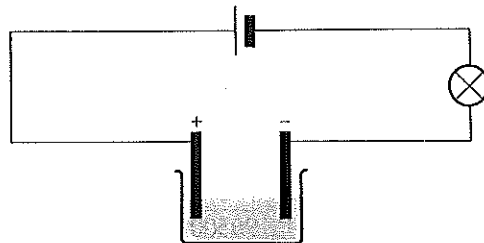


- 2 In which of these would the bulb light?

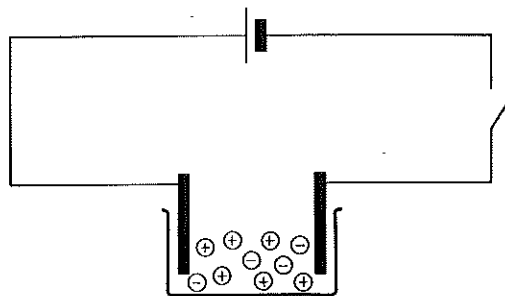


- 3 a Which of the substances in question 2 are:
 i conductors? ii non-conductors?
 iii electrolytes? iv non-electrolytes?
 b What is the difference between a conductor and an electrolyte?
 c For which substances above would you expect to see changes taking place at the electrodes?

- 4 The electrolysis of lead bromide can be investigated using the following apparatus.

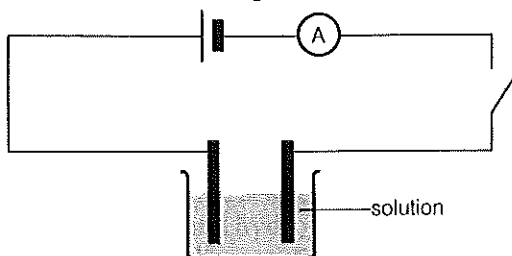


- a What must be done to the lead bromide before the bulb will light?
 b What would be *seen* at the positive electrode during the experiment?
 c Name the substance in b.
 d What is formed at the negative electrode?
 e Write an equation for the reaction at each electrode.
- 5 This question is about the electrolysis of *molten* lithium chloride. Lithium chloride is ionic, and contains lithium ions (Li^+) and chloride ions (Cl^-).
- a Which ion is the anion?
 b Which ion is the cation?
 c Copy the following diagram and use arrows to show which way:
 i the ions flow when the switch is closed;
 ii the electrons flow in the wires.



- d Write equations for the reaction at each electrode, and the overall reaction.
- 6 This question is about the electrolysis of an aqueous solution of lithium chloride.
- a Write down the names and symbols of all the ions present in the solution.
 b Lithium is a reactive metal, like sodium. What will be formed at the cathode?
 c What will be formed at the anode?
 d Write an equation for the reaction at each electrode.
 e Name two other electrolytes that will give the same electrolysis products as this one.

- 7 Write an equation for:
- the overall decomposition
 - the reaction at each electrode
- when molten sodium chloride is electrolysed.
- 8 a List the anions and cations present in:
- sodium chloride solution
 - copper(II) chloride solution
- b Write down the reaction you would expect at:
- the anode
 - the cathode
- when each solution in a is electrolysed, using platinum electrodes.
- c Explain why the anode reactions in b are both the same.
- d Explain why copper is obtained at the cathode, but not sodium.
- 9 Six substances A to F were dissolved in water, and connected in turn into the circuit below. The symbol A represents an ammeter, which is an instrument for measuring the current.

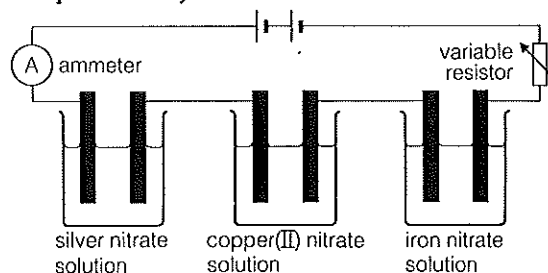


The results are shown in this table:

Substance	Current (amperes)	Cathode (-)	Anode (+)
A	0.8	copper	chlorine
B	1.0	hydrogen	chlorine
C	0.0	—	—
D	0.8	copper	oxygen
E	1.2	hydrogen	oxygen
F	0.7	silver	oxygen

- Which solution conducts best?
 - Which solution is a non-electrolyte?
 - Which solution could be:
 - silver nitrate?
 - copper(II) sulphate?
 - copper(II) chloride?
 - sodium hydroxide?
 - sugar?
 - potassium chloride?
- 10 Hydrogen chloride is a molecular substance. However, it dissolves in water to form *hydrochloric acid*, which exists as ions:
- $$\text{HCl(g)} \longrightarrow \text{H}^+(\text{aq}) + \text{Cl}^-(\text{aq})$$
- List the ions present in a solution of hydrochloric acid. What result would you expect, when the solution is electrolysed with platinum electrodes?

- 11 Aluminium is extracted by electrolysis of molten aluminium oxide. The aluminium ion is Al^{3+} .
- Write an equation for the reaction at the cathode.
 - How many moles of electrons are required to obtain 1 mole of aluminium atoms?
 - What mass of aluminium will be obtained if a current of 25 000 A flows for 24 hours? (The RAM of Al = 27; the charge due to 1 mole of electrons is 96 500 coulombs.)
- 12 Using platinum electrodes the apparatus below was set up to electrolyse three different solutions.



- Why is a variable resistor needed in the circuit?
 - Write an electron transfer equation to show how silver is formed at the negative electrode.
 - In the experiment, 0.403 g of silver was formed when a current was passed for 30 minutes. The RAM of Ag = 108; the charge due to 1 mole of electrons is 96 500 coulombs.
 - Calculate the current used.
 - Calculate the mass of copper formed in the middle cell. (The RAM of Cu = 64.)
 - In the third cell, 0.070 g of iron was obtained. The RAM of Fe = 56. Calculate whether the solution used was iron(II) nitrate (containing Fe^{2+} ions), or iron(III) nitrate (containing Fe^{3+} ions).
 - What would be obtained at the positive electrode in each beaker?
- 13 When sodium chloride solution is electrolysed, the gases hydrogen and chlorine are obtained.
- Write down the formulae for the hydrogen and chloride ions, then say which gas is obtained at each electrode.
 - Explain why hydrogen is released instead of sodium metal.
 - Write the equation for the formation of chlorine gas at the electrode.
 - How many moles of electrons are required to release 1 mole of chlorine gas (Cl_2)?
 - How many coulombs is this? (The charge due to 1 mole of electrons is 96 500 coulombs.)
 - A current of 2 A was passed for 20 minutes.
 - Calculate the volume of chlorine released at room temperature and pressure (rtp). (The volume of 1 mole of any gas is 24 dm³ or 24 000 cm³ at rtp.)
 - Explain why the volume of hydrogen released is the same as the volume of chlorine.